REPORT

OF THE

BOMBAY BACTERIOLOGICAL LABORATORY

FOR THE YEARS 1915 & 1916

BY

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BOMBAY BRANCH
OF THE
Royal Asiatic Society.

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BOMBAY BRANCH

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REPORT OF THE BOMBAY BACTERIOLOGICAL LABORATORY FOR THE YEARS 1915 AND 1916.

STAFF.

Staff.

1. The present report deals with the work carried on at the Bombay Bacteriological Laboratory during the years 1915 and 1916. Shortly after the outbreak of the War, the two Commissioned Officers of the Indian Medical Service who were assistants to the Director were transferred to Military duty.

During the period covered by the report the following officers of the Bacteriological Department assisted the Director :—

(1) Dr. D. A. Turkhud, M.B., C.M. (Edin.).

(2) Dr. S. N. Gore, L.M. & S.

(3) Dr. M. B. Soparkar, M.D. (Bombay).

ARRANGEMENT OF THE REPORT.

Arrangement of the report.

2. As usual the report has been divided into two parts setting forth under separate heads the work done :—

(*a*) as the laboratory where all the antiplague vaccine used in India and its dependencies is made, and where investigations connected with plague are carried out; and

(*b*) as the Bombay Bacteriological Laboratory where work connected with preventive medicine and pathological diagnosis for the whole of the Bombay Presidency is carried out.

Work connected with Plague.

(*a*) Routine Work.

Output in doses of antiplague vaccine for the past five years.

3. The table below gives comparative figures of output in doses of antiplague vaccine for the past five years :—

1912.	1913.	1914.	1915.	1916.
727,377	795,637	812,942	827,407	1,404,003

This table shows that each year since 1912 there has been a steadily increasing demand for antiplague vaccine and that during the year 1916, nearly a million and a half doses of vaccine have been despatched from the laboratory, the largest figure on record.

Since the laboratory was opened in 1896 up to the end of the year 1916, a period of 20 years, the total number of doses of antiplague vaccine sent out has been 14,474,206.

Distribution of antiplague vaccine.

The distribution of antiplague vaccine in India and foreign countries during the last two years is shown below (figures represent number of doses) :—

Place or Province.	1915.	1916.
Bombay Presidency and Sind ...	175,172	277,185
Madras Presidency ...	79,635	120,620
Bengal, Behar and Assam ...	9,425	9,260
United Provinces of Agra and Oudh.	52,800	76,750

Place or Province.	1915.	1916.
The Punjab ...	194,725	30,010
North-West Frontier Province ...	6,425	900
Central Provinces and Berar ...	81,030	140,570
Burma ...	65,010	56,015
Native States in India ...	91,055	502,9 8
Countries outside India ...	72,075	188,445
Portuguese Territory in India ...	55	1,290
Total number of doses ...	827,407	1,404,003

The monthly despatch was as follows :—

Month.	1915.	1916.
January	89,905	102,880
February	123,472	94,530
March	61,645	135,425
April	82,475	26,980
May	13,975	16,755
June	37,020	19,920
July	15,860	68,080
August	42,630	135,460
September	143,480	151,405
October	77,635	200,270
November ...	57,675	236,756
December.	81,635	215,542
	827,407	1,404,003

Statistics of Inoculation.

Statistics of Inoculation.

4. In the present report it has been considered expedient to curtail the statistical information showing the effect of inoculation as a plague prophylactic measure. It will suffice here to detail the effect of inoculation in a single town, Ilkal, where a careful house to house inquiry, made both during and after the plague epidemic, has furnished us with reliable statistics. We are indebted to Assistant Surgeon D. R. Vaishnav for the very careful way in which he carried out the inoculations and for his excellent report.

The town of Ilkal is situated in the Bijápur District, it has a population of 10,233 persons in normal times. Plague appeared in the town on the 6th November and continued to prevail till the 25th March 1914. The total number of deaths in and around the town during the epidemic was 146. As generally happens when plague breaks out in a town in India many people left the town and lived either in camps outside the town or in other towns and villages during the prevalence of the epidemic. A rough census of the population actually living in the town during the epidemic was first made in January 1914. It was ascertained that at that time about 1,200 persons only resided in the town. In March a second census showed that the number of residents still in the town was reduced to 1,080. Of the residents who had remained in the town throughout the epidemic 794 were inoculated and 286 were not inoculated. Among the inoculated there were 12 attacks and only three deaths while among the smaller number of uninoculated there were 35 attacks and 30 deaths.

It must be remembered that inoculation was being carried on during the course of the epidemic so that the results detailed above may give an exaggerated idea of the real value of inoculation as a plague preventive measure. For this reason a careful house to house inquiry was made and all houses in the town in which inoculated persons were living with uninoculated persons throughout the epidemic were selected for further study. A nominal roll of all the inhabitants of these houses was prepared showing who were inoculated and

who were not inoculated; the date on which inoculations were made and the date of any attack or death from plague was recorded. A study of these records showed that in seventeen houses in which inoculated were living with uninoculated, one or more of the inhabitants were attacked by plague after inoculation had been completed. In these seventeen houses there lived 63 inoculated and 39 not inoculated persons. Among the 63 inoculated persons there were four attacks and one death, among the 39 not inoculated persons there were twenty attacks and nineteen deaths from plague.

These figures show that 6·3 per cent. of the inoculated were attacked by plague and that 1·6 per cent. died of the disease while 51·3 per cent. of the uninoculated exposed to a like degree of infection were attacked and 48·7 per cent. died.

It may be of interest to record some of the more striking instances of the advantages of inoculation in particular houses. In house No. 225 there lived four inoculated and three uninoculated persons. One of the inoculated was attacked but recovered, all three uninoculated persons died of plague. In house No. 104 there were seven inoculated and one not inoculated person, the single uninoculated person was attacked and died of plague. In house No. 188 four inoculated persons lived with four not inoculated. One of the inoculated was attacked but recovered while two of the not inoculated were attacked and died. In house No. 174 three inoculated lived with one uninoculated. The uninoculated person only was attacked and died of plague.

(*b*) Research Work.

Experiments with HCN for the destruction of rats and other vermin in houses.

5. Research work in connection with plague has been restricted to the practical application of Hydrocyanic Acid Gas for the destruction of rats and fleas in houses. A number of different types of machines for generating and distributing the gas were designed and constructed. These machines were tested on a practical scale in houses in Poona City. The experiments showed that with suitable precautions this gas can be used with safety and with some success. Although some of the rats in a house were killed by the gas others survived. Rats placed in deep boxes or barrels or near the tiles of the roof of a house in which the gas was used escaped death. The gas being lighter than air failed to diffuse into deep barrels or boxes during the short period the house remained closed and the concentration of the gas was not great enough to kill the rats placed near the roof because fresh air, blown into the room through the tiles, sufficed to sufficiently dilute the gas so that it was no longer harmful to the rats.

The action of the gas on insects was found to be more marked than on mammals. Bugs, fleas, cockroaches and mosquitos were readily killed but certain grain weevils were found to be more resistant.

The gas has been successfully used to destroy bugs in hospitals and houses. A simple form of apparatus has been designed for use in hospitals for the destruction of bugs in beds, bedding and clothing.

(*c*) Assistance and Advice rendered.

Examination of rats for plague.

6. The Health Department of the City of Bombay sent daily to the laboratory all rats found dead or caught alive within the bounds of the Municipality. With each rat a note was received indicating where it had been caught or found, so that after examination it was possible to inform the Health Officer of the City where plague-infected specimens had been picked up. The Health Officer was thus able to adopt suitable measures to check the progress of the disease in the different parts of the city.

During the year 1915, seven hundred and ninety-three thousand seven hundred and five rats were received at the laboratory. Three hundred and forty-five thousand one hundred and forty-five of this number were alive when received and 448,560 were dead; 316,378 of the latter were examined and among them 4,973 proved to be infected with plague.

In the year 1916, nine hundred and forty-three thousand three hundred and fifty-two rats were received, 336,632 were alive and 606,720 were dead, of the latter 441,871 were examined and 11,227 were found infected with plague.

The following table shows the progress of plague each half month among men and rats in Bombay City during the years 1915-16. The figures which refer to men record the number of deaths from plague each half month. The figures showing the progress of the disease in rats are given separately for Mus rattus and Mus decumanus. These figures have been calculated from the number of rats found infected at the examinations made at the laboratory on every day of the week except Sundays and Holidays; from the actual figures obtained on the days on which examinations were made, a figure has been calculated for all the days of each half month and these are the figures recorded.

The table shows the close relationship between the rat epizootic and the human epidemic; the former precedes the latter by some weeks. It is interesting to note that the epidemic of the year 1916 was severer than the epidemic of 1915; this is indicated alike in the number of plague deaths among men and in the number of rats found infected. The epidemic of 1916 began to increase in severity and decline earlier than the epidemic of 1915. This observation holds true both for the human epidemic and the rat epizootic.

Return of rats examined during the years 1915 and 1916.

Period.	Human plague mortality.				Plague infected rattus.				Plague infected decumanus.			
	Number of deaths from plague.		Percentage above and below mean for the year.		Figures calculated for each half month.		Percentage above and below mean for the year.		Figures calculated for each half month.		Percentage above and below mean for the year.	
	1915	1916	1915	1916	1915	1916	1915	1916	1915	1916	1915	1916
1st to 15th January ...	1	13	—96	—84	0	65·0	—100	—4	28·7	270·0	—86	—44
16th to 31st January ...	6	28	—75	—65	14·7	97·3	—65	—3	56·0	461·3	—73	—4
1st to 15th February ...	8	51	—67	—37	15·0	114·2	—64	+14	71·2	595·4	—66	+24
16th to 28th or 29th February.	8	80	—67	—1	17·7	212·3	—58	+111	127·6	968·3	—39	+101
1st to 15th March ...	31	209	+29	+158	35·0	272·5	—17	+18	190·0	1407·5	—9	+192
16th to 31st March ...	40	259	+67	+220	45·5	274·5	+8	+173	290·5	1348·9	+39	+180
1st to 15th April ...	52	369	+117	+356	107·5	313·6	+156	+212	520·0	1494·3	+148	+211
16th to 30th April ...	103	275	+329	+240	96·9	181·4	+131	+80	645·0	1314·5	+208	+173
1st to 15th May ...	78	192	+225	+137	116·5	168·5	+177	+67	698·1	1045·4	+234	+117
16th to 31st May ...	50	151	+108	+86	78·3	114·3	+88	+14	482·5	605·7	+131	+26
1st to 15th June ...	17	34	—29	—58	38·7	47·5	—8	—53	262·5	323·7	+25	—33
16th to 30th June ...	13	44	—46	—46	22·5	55·4	—46	—45	210·0	216·9	+0	—55
1st to 15th July ...	28	37	+17	—54	35·8	30·0	—15	—70	162·7	196·2	—22	—59
16th to 31st July ...	9	32	—62	—60	32·0	40·6	—24	—60	142·9	168·6	—32	—65
1st to 15th August ...	13	12	—46	—85	28·6	31·2	—32	—69	102·3	108·5	—51	—77
16th to 31st August ...	16	22	—33	—73	18·5	27·1	—56	—73	89·8	102·2	—57	—79
1st to 15th September ...	13	17	—46	—79	17·7	17·7	—58	—82	79·1	66·8	—62	—86
16th to 30th September ...	14	16	—42	—80	21·2	32·5	—50	—68	88·7	90·0	—58	—81
1st to 15th October ...	9	17	—62	—79	21·9	31·4	—48	—69	75·0	94·1	—64	—80
16th to 31st October ...	11	21	—54	—74	44·0	39·4	+5	—61	76·0	83·6	—64	—83
1st to 15th November ...	12	14	—50	—83	42·5	46·2	+1	—54	73·7	91·2	—65	—81
16th to 30th November ...	9	16	—62	—80	33·7	46·2	—20	—54	145·0	103·8	—31	—78
1st to 15th December ...	10	10	—58	—88	50·8	68·1	+21	—32	144·2	166·2	—31	—65
16th to 31st December ...	18	23	—25	—72	72·6	88·0	+73	—13	260·9	225·3	+25	—53
Total ...	569	1,942										

(*d*) Educational Work.

7. During the years under report 53 Medical gentlemen have attended the laboratory for a course of instruction in the technique of inoculation. A number of Medical gentlemen also attended the laboratory for practical instruction in the examination of rats in order to detect plague-infected individuals.

PART II.

Work of the Laboratory as the Provincial Bacteriological Laboratory.

(*a*) Routine Work.

I.

Examinations of Pathological Fluids and Discharges, water and foodstuffs, etc.

Examinations of Pathological Fluids and discharges, water and food-stuffs.

8. (1) Blood sera for agglutination for typhoid, paratyphoid, malta fevers and cholera—132 specimens in 1915, 388 in 1916.

(2) Blood smears—328 examined in 1915, 149 in 1916.

(3) Sputa—106 specimens were examined in 1915, and the same number in 1916.

(4) Pus—26 specimens in 1915, 60 specimens in 1916.

(5) Faeces and Urine—124 specimens in 1915, 516 in 1916.

(6) Throat Swabs for Diphtheria—3 in 1915, 11 in 1916.

(7) Milk—7 specimens in 1915, 292 specimens in 1916.

(8) Water—98 specimens in 1915, 210 specimens in 1916.

(9) Other food-stuffs—28 specimens in 1916.

(10) *Post mortem* examinations were made on 108 animals from the Victoria Gardens in 1915 and 85 in 1916.

(11) A number of other miscellaneous specimens were examined in each year.

II.

Pathological tissues for diagnosis.

Classification of morbid tissues sent for examination.

9.

	1915.	1916.
I. Tumours—		
A. Non-malignant ...	40	38
B. Malignant		
(*a*) Carcinomata ...	73	55
(*b*) Sarcomata ...	33	28
II. Granulomata ...	65	47
III. Inflammatory processes and other miscellaneous tissues .	92	127
	303	295

III.

Diagnosis of Rabies.

Examination of dogs, etc., for rabies.

10. The examination of the brains of dogs and other animals for the diagnosis of rabies was made in 114 cases in 1915 and in 123 in 1916. The brains were received from the following places :—

	1915.	1916.
Bombay—		
Through the Bombay Veterinary College ...	64	61
Through the Bombay Police ...	11	6
Through Private owners ...	4	7
Outstations ...	35	49
Total examined ...	114	123

The result of the examination of these brains was as follows :—

	1915.	1916.
Received in a condition unfit for examination...	4	3
No evidence of rabies ...	42	41
Suspicious although no definite "Negri bodies" found ...	3	2
"Negri bodies" found, brains obtained from rabid animals ...	65	77

IV.

Snakes.

Snakes.

11. Poisonous snakes received at the laboratory :—

Places.	Cobras.	Russell's Viper.	Kraits.	Echis.	Total.
Bombay Presidency ...	35	34	3	894	966
Rajputana ...	6	...	...	...	6
Central Provinces ...	2	...	...	...	2
Total ...	....	...	...	...	974

V.

Mosquitos examined.

Mosquitos.

12. During the two years 880 specimens of mosquitos have been identified.

(*b*) Research Work.

Tuberculosis.

13. The study of Tuberculosis has engaged special attention. Dr. Soparkar continued his researches on the prevalence of the bovine type of tubercle in human beings in India. Up to the present date he has not been able to recover the tubercle bacillus of the bovine type from human cases of tuberculosis in India.

An interesting outbreak of bovine tuberculosis in the Victoria Gardens has been investigated.

An experiment to test the susceptibility of the Indian cattle (buffalo and cow calves) to tuberculosis has been completed. It has been shown that while on the one hand with rare exceptions all English calves die of acute miliary tuberculosis when inoculated with 50 milligrammes of a culture of bovine tubercle bacillus on the other hand 50 per cent. of Indian calves, whether they are buffalo or cow calves, live for many days after a similar dose of the bovine tubercle bacillus and when killed showed retrogressive or healing tubercular lesions. This finding is in agreement with the general experience that Indian cattle are less commonly affected by Tuberculosis than English cattle are and supports the view that the comparative infrequency of the disease among cattle in India is due to a natural resistance to the disease rather than to any method of housing or keeping cattle in India as compared with Europe. Some Indian calves however were found to die quickly after the subcutaneous injection of even ten milligrammes of culture so that Indian calves showed a greater individual variation in susceptibility to infection by the tubercle bacillus than English calves. It follows that the comparative rarity of Tuberculosis in Indian cattle must in part at least be attributed to diminished opportunities for acquiring infection. The possible existence of tuberculosis among imported breeds of cattle and their liability to contract tubercular infection is therefore a source of danger to indigenous herds.

II.

Leprosy.

14. The treatment of Leprosy with Chaulmoogra oil and its derivatives is being investigated by Dr. Turkhud and other members of the staff of the Laboratory.

III.

Guineaworm Disease.

15. Investigations in connection with Guineaworm disease still continue to be carried on.

IV.

Syphilis.

16. The treatment of syphilis with substitutes for Salvarsan has been tested by Major Liston, I. M. S., and Khan Saheb Assistant Surgeon Avari. Kharsivan and Arsenobillon have been proved to be useful substitutes for Salvarsan.

V.

Bilharziasis.

17. The possibility of the introduction of Bilharziasis into India by troops returning from Egypt and Africa is under investigation by Major Liston and Dr. Soparkar.

VI.

18. Methods for the isolation of typhoid and paratyphoid bacilli and cholera vibrios from the stools of infected persons have been studied by Dr. Gore and Assistant Surgeon Dalal.

Typhoid.

VII.

19. The bacteriological examination of water with special reference to the identification of cholera and cholera-like vibrios has been studied by Assistant Surgeon Gore.

Cholera.

(c) Assistance and Advice rendered.

20. The staff of the laboratory has endeavoured to render every assistance to the Military Authorities. In addition to supplying 380,190 doses of antiplague vaccine and 68,915 doses of other bacterial vaccine the laboratory has made and supplied 14,108 tubes of tincture of iodine for making antiseptic solutions and 48,000 bulbs of tincture iodine for shell dressings. Seven hundred and sixty-four doses of different sera, and bacteriological equipment valued at Rs. 8,533 have been supplied for military purposes. Numerous tests, especially of antiseptics, have been made for the Medical Stores Depôt.

Assistance rendered to the Military Department.

Vaccines supplied.

Towards the end of June 1916 the great increase in the number of sick arriving in Bombay from Mesopotamia and East Africa led to the expansion of Hospital accommodation in Bombay and the need arose for specialist medical services. It was under these circumstances that the resources and staff of the Bombay Bacteriological Laboratory were placed at the disposal of the Director, Medical Services, and under his orders the charge and organisation of the Pathological and Bacteriological work of the War Hospitals in Bombay was undertaken by the Director of the Laboratory with the assistance of his staff in addition to their other duties.

Bacteriological and Pathological work in the Bombay War Hospitals.

The centralising of the bacteriological and pathological work of the War Hospitals at Parel effected great economy in material and equipment. The services of the staff of the laboratory, which were voluntarily rendered, secured a sufficiency of trained men to enable the rapidly increasing work to be accomplished efficiently and well. A separate report has been furnished dealing with the bacteriological and pathological work done at the War Hospitals; it will suffice here to mention that at the Bombay Bacteriological Laboratory 6,506 samples of blood were examined by the Widal test up to the close of the year. One hundred and twenty different strains of organisms chiefly typhoid, paratyphoid, dysentery and cholera have been carefully examined and identified. Two hundred and seventy-five samples of milk have been analysed and a large number of other specimens totalling in all 149,657 have been examined at Parel in connection with this work.

On the 16th August 1916 the services of Captain Knowles, I. M. S., were placed at the disposal of the Director. He was placed in charge of the Pathological work at the Cumballa War Hospital where 1,683 specimens were examined. Captain Knowles' services were transferred to the Pasteur Institute, Assam, on 2nd December 1916, and Captain Napier, R.A.M.C., took up Captain Knowles' duties from that date.

Assistant Surgeon Fox and Assistant Surgeon Menezes were placed in charge of the branch Bacteriological Laboratories at the Gerard Freeman Thomas War Hospital and the Colaba War Hospital. At the former 4,507 and at the latter 5,096 specimens were examined. At the other War Hospitals in Bombay, 3,473 specimens were dealt with.

Towards the end of July the number of convalescent typhoid and paratyphoid cases in the Bombay War Hospitals awaiting accommodation in the then existing Enteric Depôts was so large as to seriously interfere with the proper functions of the War Hospitals. It was suggested that an Enteric Depôt could be opened at the Bombay Bacteriological Laboratory where accommodation was available

Enteric Depôt at Parel.

in the rooms provided for the School of Research in Tropical Medicine which had not been opened owing to the outbreak of War. The suggestion was adopted and the preparation of the accommodation and the organisation of the Depôt was left to the Director of the Laboratory who was appointed Officer Commanding the Depôt. There was at the time no other staff. A Sergeant-Major, Quartermaster Sergeant, Clerks, Cooks, etc., were obtained from among the convalescent enteric patients in the War Hospitals in Bombay and the Depôt was opened on the 14th August 1916 with 12 patients. On August 17th Captain Cruickshank, I. M. S., joined as Medical Officer, and on the 18th Assistant Surgeon LaFrenais reported for duty.

On the 18th and 19th one hundred and twenty-four patients were admitted making the total of 136 in the Depôt at this date.

Owing to delay in installing an engine and dynamo for lighting the building the number of patients accommodated in the Depôt did not reach 300 until November 14th.

At first the whole working arrangements of the Depôt had to be organised; dining halls and cook houses had to be completed; recreation room and playing fields prepared. The various duties and rules for discipline had to be laid down; contracts arranged for food and washing; the preparation of additional accommodation and numerous small alterations in connection with the building arranged.

The office and methods of keeping records of the patients were organised, and arrangements made for patients to draw a certain amount of pay and in some cases to send money home. There was also a considerable amount of work entailed in dealing with and treating the daily sick. A dispensary was fitted up, also a sick ward and orderlies obtained from among the convalescents.

The convalescence of the patients was assisted by a careful observation of each patient; graduated forms of exercise were arranged so that when the patients had completed the necessary examinations to ascertain whether they were carriers or not the majority were fit to return to duty.

The scheme for the laboratory work had also to be arranged. A room was furnished and fitted up as a laboratory. The routine laboratory examinations were started on 18th September beginning with ten patients. On September 21st the daily number examined was twenty, by the 28th the number was increased to thirty daily. On and after the 31st October the number of cases examined daily was 50. It was necessary to gradually increase the number of patients examined because laboratory assistants had to be trained and the scheme of operations developed and systematised.

The work had increased so greatly that additional assistance became necessary. Captain Heaton, R.A.M.C., joined the Depôt on the 16th October and Lieutenant Mackenzie Wallis on the 10th November 1916. Captain Heaton took charge of the daily sick and assisted in the Quartermaster's department and in the laboratory of the Depôt. Lieutenant Mackenzie Wallis' services were utilised as a chemist. He devoted his attention to the preparation of a substitute for "nutrose" which is an ingredient of a commonly used medium for the cultivation of the typhoid bacillus. "Nutrose", being a German patent preparation was no longer obtainable in the market. Lieutenant Mackenzie Wallis prepared Nutrose and has described the preparation and the use of this valuable food in a paper published in the Indian Journal of Medical Research, Volume 4, No. 4. In the same journal he has published a paper on the use of Aromatic Chloramine compounds for the sterilisation of water for drinking purposes.

From the date the Enteric Depôt was opened at the Bombay Bacteriological Laboratory 523 patients passed into it and 229 men have been discharged from the Depôt after completing their course of examinations. Six of them harboured Bacillus paratyphosus A, while one carried the Bacillus typhosus. All the para. A cases were fæcal carriers. The case excreting Bacillus typhosus had a sinus connected with the sternum from which a pure culture of the bacillus could always be obtained.

(*d*) Educational.

Popular lectures.

21. Popular lectures and demonstrations have been arranged with the object of instructing teachers and scholars in the causes and prevention of disease. Two pamphlets written in simple language and freely illustrated have been prepared by the Director and printed and published by the Indian Research Fund Association. One pamphlet deals with Tuberculosis, the other with Guineaworm Disease. Lantern slides can be obtained from the laboratory to illustrate these lectures.

Assistance afforded to Sanitary Associations.

Assistance has been given to a number of Sanitary Associations in preparing popular demonstrations. A particularly successful Conference was held under the auspices of the Surat Sanitary Association. The Director of the Laboratory delivered a lecture at this Conference on "Insect Carriers of Disease" illustrated with cinematograph films. He also lectured on "Milk supplies" and illustrated the lecture with lantern slides.

A perusal of this report will show that the work of the laboratory has greatly increased and expanded during the past two years. The difficulties of securing supplies from England and the pressing demands made on the laboratory owing to the War have called forth the most strenuous efforts from all the staff of the laboratory. I take this opportunity of thanking them for their loyal co-operation and help.

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